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Title: Correlation Between Soil Moisture and Dust Emissions: An Investigation for Global Climate Modeling

Abstract:

This work is using the newly available NASA SMAP soil moisture measurement data to evaluate its impact on the atmospheric dust emissions. Dust is an important component of atmospheric aerosols, which affects both climate and air quality. In this work, we focused on semi-desert regions, where dust emissions show seasonal variations due to soil moisture changes, i.e. in Sahel of Africa. We first identified three Aerosol Robotic Network (AERONET) sites in the Sahel (IER_Cinzana, Banizoumbou, and Zinder_Airport). We then utilized measurements of aerosol optical depth (AOD), fine mode fraction, size distribution, and single-scattering albedo and its wave-length dependence to select dust plumes from the available measurements We matched the latitude and longitude of the AERONET station to the corresponding SMAP data cell in the years 2015 and 2016, and calculated their correlation coefficient. Additionally, we looked at the correlation coefficient with a three-day and a five-day shift to check the impact of soil moisture on dust plumes with some time delay. Due to the arid nature of Banizoumbou and Zinder_Airport, no correlation was found to exist between local soil moisture and dust aerosol load. While IER_Cinzana had soil moisture levels above the satellite threshold of 0.02cm3/cm3, R-value approaching zero indicated no presence of a correlation. On the other hand, Ilorin demonstrated a significant negative correlation between aerosol optical depth and soil moisture. When isolating the analysis to Ilorin's dry season, a negative correlation of -0.593 was the largest dust-isolated R-value recorded, suggesting that soil moisture is driven the dust emission in this semi-desert region during transitional season.